ACT Activities

Examples align with Transportation, Distribution, & Logistics course standards

Career Cluster: Transportation, Distribution, & Logistics

Science in *Automotive Maintenance & Light Repair II* – Addresses Standards 3.2, 3.3

Question

Passage III

An electrical circuit contained a 12-volt (V) battery, a *resistor* (a device that resists the flow of electricity), a *capacitor* (a device that stores electrical charge and electrical energy), a *voltmeter* (an instrument for measuring voltage), and a switch, as shown in Figure 1. Some students studied the behavior of the circuit.

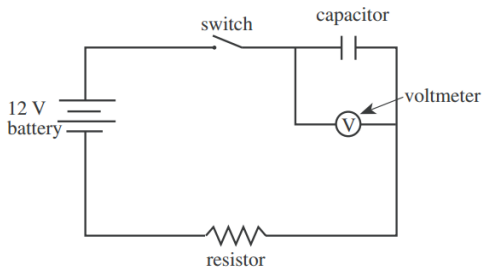


Figure 1

Experiment 1

The students used a $\mathbf{1} \times \mathbf{10^7}$ ohm (Ω) resistor and a capacitor with a *capacitance* of $\mathbf{1} \times \mathbf{10^{-6}}$ farad (F). (Capacitance is a measure of the maximum amount of electrical charge and electrical energy a capacitor can store.) The capacitor was initially uncharged. At time zero, the students simultaneously closed the switch and started a stopwatch. At time zero and at 12 sec intervals thereafter, they recorded the voltage across the capacitor. Their results are shown in Table 1.

Table 1

Time (sec)	Voltage across capacitor (V)
0	0.0
12	8.4
24	10.9
36	11.7
48	11.9
60	12.0

Experiment 2

Using the $\mathbf{1} \times \mathbf{10}^{\mathbf{7}}\ \Omega$ resistor and several different capacitors, the students determined the length of time from when the switch was closed until the voltage across the capacitor reached 6 V. Their results are shown in Table 2.

Table 2

Capacitance ($\times 10^{-6}$ F)	Time to reach 6 V across capacitor (sec)
1.2	8.3
0.6	4.2
0.3	2.1
0.1	0.7

Experiment 3

The students conducted the same procedure described in Experiment 2, except that they used a constant capacitance of $\mathbf{1} \times \mathbf{10}^{-\mathbf{6}}$ F and several different resistors. Their results are shown in Table 3.

Table 3

Resistance ($\times 10^{7}\ \Omega$)	Time to reach 6 V across capacitor (sec)
0.75	5.2
0.50	3.5
0.25	1.7

14. In Experiment 1, the time constant of the circuit was the time required for the voltage across the capacitor to reach approximately 7.6 V. The time constant of the circuit used in Experiment 1 was:

F. Less than 12 sec.
G. Between 12 sec and 24 sec.
H. Between 24 sec and 36 sec.
J. Greater than 36 sec.

15. If, in Experiment 2, a $\mathbf{1.5} \times \mathbf{10}^{-\mathbf{6}}$ F capacitor had been used, the time required for the voltage across the capacitor to reach 6 V would have been closest to:

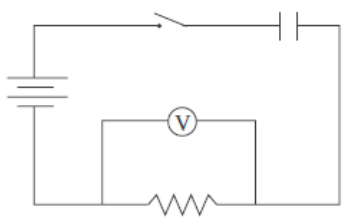
A. 4.2 sec.
B. 7.0 sec.
C. 10.5 sec.
D. 15.0 sec.

16. The main purpose of Experiment 3 was to determine how varying the:

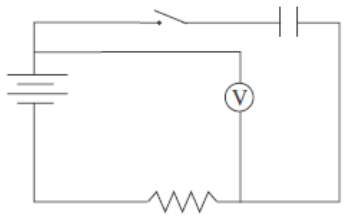
F. Battery's voltage affected the resistor's resistance at a given time.
G. Capacitor's capacitance affected the time required for the voltage across the capacitor to reach a set value.
H. Capacitor's capacitance affected the voltage across the battery at a given time.
J. Resistors resistance affected the time required for the voltage across the capacitor to reach a set value.

17. Based on Figure 1, to measure the voltage across the resistor only, which of the following circuits should one use? (correct answer is A)

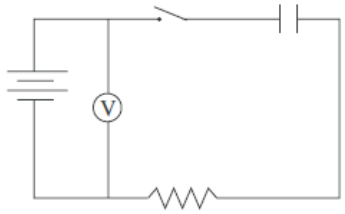
A.



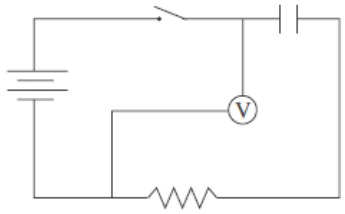
B.



C.



D.



18. Consider a circuit like that shown in Figure 1. Based on Experiments 2 and 3, the voltage across the capacitor will reach a given value in the shortest amount of time if the circuit contains which of the following capacitances and resistances, respectively?

F. $\mathbf{0.1 \times 10^{-6}}$ F, $\mathbf{0.3 \times 10^{7}}$ **Ω**
G. $\mathbf{0.1 \times 10^{-6}}$ F, $\mathbf{1.0 \times 10^{7}}$ **Ω**
H. $\mathbf{1.2 \times 10^{-6}}$ F, $\mathbf{0.3 \times 10^{7}}$ **Ω**
J. $\mathbf{1.2 \times 10^{-6}}$ F, $\mathbf{1.0 \times 10^{7}}$ **Ω**

19. Consider the following hypothesis: In a circuit arranged as in Figure 1 containing a battery, a capacitor, and a constant resistance, as capacitance increases, the time required to reach a given voltage across the capacitor increases. Do the experiments support this hypothesis?

A. Yes; in Experiment 1, as capacitance increased, the time required to reach a given voltage increased.
B. Yes; in Experiment 2, as capacitance increased, the time required to reach a given voltage increased.
C. No; in Experiment 1, as capacitance increased, the time required to reach a given voltage decreased.
D. No; in Experiment 2, as capacitance increased, the time required to reach a given voltage decreased.

Source: *Preparing for the ACT Test*. (2007). Retrieved from http://www.collegetidbits.com/tools/preparing-for-the-act.pdf

Career Cluster: **Transportation, Distribution, & Logistics**

Mathematics in *Introduction to Collision Repair* – Addresses Standard 12

Question

The lead of a screw is the distance that the screw advances in a straight line when the screw is turned one complete turn. If a screw is $2\frac{1}{2}$ inches long and has a lead of $\frac{1}{8}$ inch, how many complete turns would get it all the way fastened?

A. 5
B. 10
C. 15
D. 20
E. 25

The correct answer is D. 20. With every complete turn $\frac{1}{8}$ inch of the screw goes into the wood. So after 8 complete turns, 1 inch of the screw would be in the wood. So, $x\left(\frac{1}{8}\right) = 2\frac{1}{2}$. Multiplying by 8, $x = 8\left(2\frac{1}{2}\right) = 8\left(\frac{5}{2}\right) = 20$.

Source: *Sample Mathematics Questions: Set 2. (2016). Math Questions. ACT, Inc.,* Retrieved from http://www.actstudent.org/sampletest/math/math_02.html